Cohen's by saying that whilst the former was largely an accumulation of facts, the latter is chiefly an exposition of theories and principles. There is much less recital and much more discussion. The mechanism of the chemical reaction, rather than the properties of the product, is now insisted on; and rightly so, for this aspect of the matter is the more philosophically interesting and scientifically valuable.

In the first chapter, dealing with the valency of carbon, we come at once into a region where speculation and discussion are rife. The author explains the chief theories which have been propounded to account for the existence of bivalent and tervalent carbon, unsaturated groups, labile forms, and so on. He then passes to the consideration of the nature of organic reactions, including such processes as the addition of elements or groups to unsaturated compounds, autoxidation, catalytic reduction and oxidation, condensation, and the formation of chains and rings. The portions dealing respectively with Thiele's theory of partial valencies and with condensation processes will be found especially useful. Indeed, these first two chapters of the work, with their references, might well have served as the basis for the address of the president of Section B at the recent meeting of the British Association.

In chapter iii. we have an exposition of the dynamics of organic reactions. It is satisfactory to note that many of the examples are drawn from the Transactions of the Chemical Society of London—as indeed is the case throughout the book.

Molecular volume, refractivity, dispersivity, magnetic rotation, thermochemistry, and absorption-spectra are next dealt with, and the results applied to problems of molecular architecture. An interesting discussion of the relations between colour and structure follows, and the book ends with an account of the photochemistry of organic compounds.

Occasionally it is not too clear which of two or more theories the author adopts, or favours; but a student who masters the substance of this and the companion volume will be justified in considering himself well grounded.

(2) The first edition of this work has been favourably known for several years to chemists and others concerned with essential oils. To use the translator's phrase, it was "a happy blending of history with chemical science and technology"; and this characteristic is maintained in the new edition. Two volumes, however, are now required, the one under review containing (*inter alia*) the historical matter. This has received additions here and there, but remains substantially as when first published. The authors outline the development of the trade in spices and aromatics during the Middle Ages, and trace the general history of the volatile oils—the essential principles of most spices and aromatic plants—from early Egyptian times onwards. Following this are sections giving the history of the individual volatile oils and of distillation processes. The whole forms an interesting and valuable monograph, enriched with numerous references and quotations; the sketches of ancient distilling apparatus and the photographs of their modern successors are worthy of note for the contrast they offer.

Distillation is a subject closely connected with that of volatile oils, since these are usually obtained by distilling the oil-bearing plants with steam. Not always, however; in certain cases heat destroys the delicacy of the perfume, or the oil does not separate from the condensed water. In such instances the oil is either extracted direct from the flowers with a volatile solvent such as petroleum ether, or absorbed by a suitable fat (*enfleurage*: maceration). These processes are described by the authors in the next chapter, after which the general chemical constituents of the oils are dealt with. The chapter describing these is the longest and most important in the book. All necessary information appears to be given, including numerous structural formulæ, and lists of the plants in which each constituent has been found.

Finally, there is an account of the general physical and chemical methods used in the assay of volatile oils, with notes on adulterants, and two useful analytical tables. The characters of the individual oils are not dealt with in the present volume, but the new edition of "Gildemeister" promises to be the best work on volatile oils which has yet appeared in English.

C. S.

OUR BOOKSHELF.

Early Wars of Wessex: Being Studies from England's School of Arms in the West. By A. F. Major. Edited by the late Chas. W. Whistler. Pp. xvi+238. (Cambridge: University Press, 1913.) Price 10*s.* 6*d.* net.

"WESSEX had to face a determined enemy, which was the most important factor in her steady rise to power" (p. 87). "The western Wessex frontier was for two centuries practically the school of arms for England" (p. 91). After the wedge of Anglo-Saxon conquest was driven to the Severn by the battle of Deorham in 577, separating the Welsh of the Cornish peninsula from their kindred, the Welsh kingdom of Dyvnaint (Dumnonia) kept its independence for two centuries. The Cornish kingdom held out for another century. It was the Welsh that kept this famous "school of arms" going, and it took Wessex some 350 years altogether to learn its lessons (p. 83).

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Such, in brief, is the "burden" of this erudite but eminently readable book. It is a fine textbook of open-air history, an attempt to write history "writ large on the face of the country" (p. vii). The available documents are read and expounded *in situ,* so to speak. Archæology, traditions, and folklore "assign their true value to records which have hitherto been loosely read" (p. viii). Accounts of the Scandinavian invasions of western England are read, very properly, in the light of northern antiquities. The first Danish invaders allied themselves with the "bottled-up" "One and Alls," and we learn much about peaceful Danish settlements on the coasts of the Severn. Two archæological maps, many plans and diagrams of camps, and a copious index mark the thoroughness and finish which characterise the whole work. JOHN GRIFFITH.

The British Journal Photographic Almanac, 1914. Edited by G. E. Brown. Pp. 1496. (London: Henry Greenwood and Co.) Price 1*s.* net.

To photographers the approaching end of the year and the beginning of a new one is always heralded by the announcement of the publication of this almost indispensable year-book, which is so familiar to them and a natural fixture in their studios. The copious material contained between the two covers and the useful facts embodied in it has made it a book of reference difficult to part with. The issue for this year follows mainly the lines of its predecessors, but new features of course have been inserted. These, to state them briefly, comprise a glossary of photographic terms, which, no doubt, will be helpful to many a beginner in the subject of photography.

Lists are given of the German, French, and Italian equivalents for the chief appliances and operations, and these should be most serviceable to those who study foreign photographic journals and books, but have no technical dictionary at their elbow. The beginner is also favourably treated with an excellent series of reproductions of negatives incorrectly exposed and developed, which should show him more than words can express what he must avoid; the accompanying text will also prove of service. The epitome of progress, novelties in apparatus, formulæ for the principal photographic processes, miscellaneous information, tables, &c., are as full and complete as ever, and the great number of advertisements are a valuable feature of the volume.

Hazell's Annual for 1914. Edited by T. A. Ingram. Pp. cxiii+592. (London: Hazell, Watson and Viney, Ltd., 1914.) Price 3*s.* 6*d.* net.

IN addition to its revision up to November 25 last, this twenty-ninth issue of "Hazell's Annual" contains a section entitled "Occurrences during Printing." It justifies its claim to give the most recent information on the topics of the day. A section running to some forty pages is headed "The March of Science," and provides a summary of progress made in the world of science during 1913. An index containing 10,000 references makes it easy for the reader to find his way about the volume.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

The Pressure of Radiation.

WITH reference to my letter on this subject in NATURE of December 18, the majority of my correspondents complain that, although I may have indicated the possibility of my own view, I have not shown why the simpler relation, that the pressure is always one-third of the energy density, is untenable. As I cannot reply to each individually, I shall be glad if you will allow me space to rectify this omission.

It is generally admitted that the total heat required for the emission (or evolved in the absorption) of unit volume of radiation is the sum of the intrinsic energy density, E/v, and the external work p. By Carnot's principle, this must be equal to $T(dp/dT)$. Whence, if $E/v=3p$, we obtain immediately the fourth power law for full radiation in the usual manner. It would appear, however, by similar reasoning, if E/v is equal to $3p$ for each separate frequency, that radiation of constant frequency should also increase with temperature according to the fourth power law, which is certainly not the case. Either Carnot's principle does not apply, or E/v is not equal to $3p$ for each separate frequency. I have chosen the latter alternative.

It has been shown by Lord Rayleigh, Lorentz, Larmor, Jeans, and others that the electromagnetic equations (from which $E/v=3p$ was first deduced) lead inexorably to Rayleigh's formula,

$$E_\lambda=8\pi R\lambda^{-4}T/N,$$

without the exponential term, for the partition of energy in full radiation per unit range of wavelength λ. This result appears to be true in the limit for long waves and high temperatures, but is otherwise so hopelessly at variance with experiment as to suggest that something may have been overlooked in the application or interpretation of the equations.

Some of my correspondents point out that Nichols and Hull have already shown by experiment that the pressure of a beam of light is equal to the energy density irrespective of wave-length. According to my theory, the mechanical effect which they measured should be equal to the total energy density, $E/v+p$, as deduced from their energy measurements. Their result is in perfect agreement with my theory, but it is not quite such a simple matter (and may even prove to be impossible) to measure p separately from E/v, which is the experiment that I proposed to attack.

H. L. CALLENDAR.

Imperial College of Science, S.W.,
December 27, 1913.

Atomic Models and X-Ray Spectra.

MR. H. G. K. MOSELEY has published in the December issue of the *Philosophical Magazine* a very interesting paper describing his measurements of the wave-lengths of the characteristic X-ray lines of various metals. He has succeeded in calculating the wave-lengths of one-half of the lines he observed, assuming Bohr's atom and supposing the positive charge on the nucleus to correspond to the place of the element in the periodic table as suggested by van den Broek. He concludes that the agreement between calculated and observed wave-lengths strongly supports the views of Rutherford and of Bohr.

It appears to me that Moseley's research really only supports the views of Rutherford and of van den Broek. As I propose to show in detail in a paper to

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